

REPORT BY THE
AUDITOR GENERAL
OF CALIFORNIA

THE INTEGRATED CONTROL SYSTEM OF THE BAY AREA
RAPID TRANSIT DISTRICT COSTS MORE, HAS A LESS
COMPREHENSIVE DESIGN, AND HAS TAKEN LONGER TO
COMPLETE THAN ORIGINALLY PLANNED

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P-742

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Auditor General

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P-742

Honorable Art Agnos, Chairman
Members, Joint Legislative
Audit Committee
State Capitol, Room 3151
Sacramento, California 95814

Dear Mr. Chairman and Members:

The Office of the Auditor General presents its report concerning the Bay Area Rapid Transit District's Integrated Control System project. The report indicates a need for the Bay Area Rapid Transit District to better assess its own capabilities for managing technical projects in the future, and to select a new contractor for the Integrated Control System if upcoming tests of the system indicate that the current contractor cannot successfully complete the project.

Respectfully submitted,

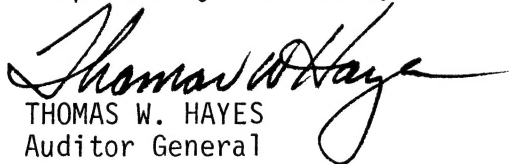

THOMAS W. HAYES
Auditor General

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SUMMARY

RESULTS IN BRIEF

The San Francisco Bay Area Rapid Transit District (BART) is paying more money than it anticipated for the Integrated Control System (ICS), a computer system used to automatically supervise trains, even though the ICS has a less comprehensive design than was provided for in the original contract with the Lawrence Berkeley Laboratory in 1980.

BART has increased its estimate of the cost of the project by more than \$25 million and has delayed the expected date of completion by more than five years. BART's attempt to assume responsibility for technical management of the project during 1983 and 1984, BART's changes in the design of the system, and the current contractor's failure to deliver an acceptable plan until August 1986 contributed to these problems. While BART has taken corrective actions to improve this situation, BART may still need to hire a different contractor than Logica Systems, Incorporated (Logica), the current contractor. BART acknowledges this possibility and has conducted some research to determine the amount another contractor would charge to complete the project; however, BART has determined that the cost of hiring a new contractor would exceed the cost of retaining Logica. Finally, as a result of our audit work, BART has taken actions to recover \$28,000 in overpayments to the present contractor.

BACKGROUND

BART has provided transportation services in the San Francisco Bay Area since 1972. Primarily an interurban railway system, BART links various suburban communities with San Francisco and Oakland. BART's management and board of directors have known since 1976 that BART's computer system for supervising

trains contains obsolete equipment and must be replaced to meet the future needs of BART's riders and to facilitate expansion. In 1977, BART and the Lawrence Berkeley Laboratory (laboratory) began a joint effort to develop the ICS to address this problem. In 1983, BART ended its agreement with the laboratory and contracted with Logica Systems, Incorporated, for the completion of the ICS project. Currently, Logica is still the primary contractor for the ICS project.

PRINCIPAL FINDINGS

The Development of the ICS Has Been More Complicated Than BART Anticipated

On several occasions, BART staff underestimated the cost of the equipment and labor needed to complete the ICS. In addition, BART made major changes in the design of the ICS and attempted, unsuccessfully, to take responsibility for the technical management of the project. Also, Logica had to correct deficiencies in the plan that it had developed for the ICS, thereby delaying the project's completion. As a result of these conditions, estimates for the total cost of the ICS have increased by more than \$25 million, and the target date for its completion has been delayed by more than five years.

BART Has Improved Its Contract With Logica But Some Portions Remain Unfavorable to BART

While BART has improved its contract with Logica, some portions of the current agreement remain unfavorable to BART. The current contract establishes a cost-sharing arrangement for cost overruns in any stage of the project and specifies key personnel that Logica must assign to the ICS. However, the contract does not ensure that the ICS will be completed for \$39.6 million, BART's most recent estimate for the ICS. In addition, the agreement limits

Logica's liability for breach of contract to \$1.6 million. Nevertheless, BART staff have concluded that retaining Logica will be less costly than hiring a new contractor.

BART Paid Logica \$28,000 More Than It Was Entitled To Receive

BART's Contract Management Department regularly reviews contractors' timesheets and the corresponding invoices to ensure that contractors receive appropriate payments. However, between January and June 1986, this review was not conducted for the ICS because BART had not authorized funds to pay Logica for its work. BART later reimbursed Logica through special check requests, bypassing the normal review procedure. Our review revealed inappropriate payments during this six-month period, and BART has since taken actions to recover approximately \$28,000 that it paid inappropriately to Logica for work on the ICS. In addition, BART has taken corrective actions to prevent additional overpayments.

RECOMMENDATIONS

To ensure that any major future technical projects are conducted effectively and efficiently, the Bay Area Rapid Transit District should secure the short-term services of expert consultants who can accurately assess BART's ability to assume responsibility for the technical management of each project and who can recommend the type of contract that BART should offer for each project; and

To ensure that the development of the Integrated Control System is conducted effectively and efficiently, BART should analyze the results of upcoming tests of the ICS to determine if BART should cancel its contract with Logica Systems, Incorporated, and select a new contractor to complete the project.

AGENCY COMMENTS

In responding to this report, the acting general manager of the Bay Area Rapid Transit District stated that he had no comments to offer.

INTRODUCTION

The San Francisco Bay Area Rapid Transit District (BART) was formed in 1957 by the California State Legislature to ensure "necessary rapid transit service" in the San Francisco Bay Area. BART, which began providing transportation services in September 1972, is primarily an interurban railway system connecting suburban communities with San Francisco and Oakland. Currently, BART operates trains over 71 miles of track in three different Bay Area counties, and during fiscal year 1986-87, BART estimates that passengers took 1.1 million trips per week on BART trains.

In its 1987 Five-Year Plan, BART estimates that, for fiscal year 1987-88, its operating revenues will be approximately \$86 million while its operating expenses will be about \$174 million. The estimated operating deficit of \$88 million will be financed primarily from local property and sales tax revenues in addition to state transportation assistance funds. The 1987 plan also states that ridership levels will be constrained unless, by 1990, BART can operate trains with only 2 minutes and 15 seconds between them. To accomplish this goal, BART needs to complete several projects, including improvements to the train-reversing facility at Daly City, the addition of new train cars, and the development of the Integrated Control System (ICS), a new system for supervising trains.

BART's existing system for the automatic supervision of trains, electrification, and support functions such as ventilation is known as the Central Train Computer Control System. This system supervises only the routing and scheduling of trains, and the ICS, which will replace it, will perform the same functions. Since all train movements are controlled by separate computer systems known as the Automatic Train Protection System and the Sequential Occupancy Release System, BART's project manager for the ICS has stated that neither the ICS nor the existing Central Train Computer Control System are responsible for ensuring that BART's trains operate safely.

In August 1976, BART, in conjunction with the University of California's Lawrence Berkeley Laboratory (laboratory), issued a report on BART's computer needs. This report stated that the existing Central Train Computer Control System could not supervise more than 50 trains and that the existing computer system was obsolete. Moreover, the firm that BART purchased these computers from no longer manufactured them, thus making it difficult for BART to maintain them.

BART's acting general manager has stated that, currently, the existing train control system cannot supervise more than 55 trains at one time, with an increase to 60 trains possible by November 1987. Once it is developed, the ICS should enable BART to operate 74 trains initially with the capability of expanding the control system to 115 trains. BART's acting general manager has stated that, while the ICS is not needed to meet current demand, it will be needed for expansion.

BART had been involved in contracts with the laboratory since 1974, and, in 1977, the two organizations began a joint effort to develop a preliminary design for the ICS. By 1980, BART and the laboratory had entered into a three-year contract for \$2.59 million to develop the ICS. This contract made the laboratory responsible for managing the ICS project team, which was composed of staff from both BART and the laboratory. The team was responsible for designing the computer hardware and software systems for the ICS; developing, implementing, and integrating these systems; and verifying the capability of the entire ICS.

In a presentation to the federal Urban Mass Transportation Administration in 1980, BART indicated that the laboratory was uniquely qualified to perform the necessary work for developing the ICS. In its presentation, BART also stated that all of its previous computer systems were developed on a "turnkey" basis--BART gave the design specifications over to the contractor, who then delivered a finished product. However, BART had decided to take a more active role in this project and had chosen to organize the ICS project as a joint effort with the laboratory. BART management made this decision to ensure that it would not experience problems that are sometimes associated with turnkey contracts, such as incomplete documentation and training for operating the system. This joint effort also allowed BART to influence the product's development.

However, in a letter dated July 19, 1982, to BART's board of directors, BART's general manager stated that the conceptual design for the ICS was essentially complete and that laboratory staff preferred to substantially decrease their involvement while BART procured the services of another contractor to implement the design. The general manager explained that conflicts between staff members of the two organizations had limited the success of the joint effort. The laboratory's associate director for administration has stated that the joint effort was dissolved because BART had proposed a change to the contract that would have given BART direct technical supervision of laboratory employees, a condition that was contrary to the policies of both the University of California and the federal Department of Energy. As a result of these differences, BART issued a request in August 1982 for contract proposals to continue work on the ICS project and, shortly after, awarded a contract to the current contractor, Logica Systems, Incorporated (Logica). (See Appendix A for a detailed history of BART's contract with Logica.)

SCOPE AND METHODOLOGY

The purpose of our review was to identify the reasons for the increase in the estimated cost of the ICS and the reasons for the delay in its completion. In addition, we evaluated BART's management of its contract with Logica.

To determine BART's effectiveness as contract manager for the ICS project, we reviewed all contracts and change orders for the contracts with the laboratory and Logica, the two main contractors involved in the project. We compared these contracts with contracts that state agencies use for long-term technical projects. In addition, we reviewed all correspondence and reports involving these two contractors during the history of the project.

We also conducted a survey of private firms to help us determine whether the hourly rates that Logica was charging BART for developing the ICS were comparable with the rates other firms would charge for this type of work. However, we received only limited cooperation from these firms and were not able to verify the data they provided.

To determine whether BART was paying Logica the appropriate amount for work conducted on the ICS, we examined timesheets for Logica employees from four months that were selected randomly from the 24-month period from April 1985 through March 1987. We then cross-checked these timesheets against the corresponding invoices. These 24 months represent \$4.92 million, or 55 percent of BART's payments to Logica, as of August 31, 1987. After detecting an error in these payments for the month of April 1986, we examined two additional months with characteristics similar to the month containing the error. We also reviewed both the manual and computer systems that BART uses

for ensuring appropriate payments to Logica, and we reviewed the documents that Logica submitted to support its charges for expenses other than labor.

Finally, we examined BART's basis for awarding contracts to the laboratory in 1980 and to Logica in 1983. Specifically, we reviewed BART's criteria for selecting a contractor in addition to the analyses BART conducted before awarding these contracts. Also, we reviewed the terms of these contracts to determine whether the contractors had fulfilled their obligations to deliver products, progress reports, and professional services. Except for the project plan discussed later in the report, we found few weaknesses in these areas.

AUDIT RESULTS

I

THE DEVELOPMENT OF THE INTEGRATED CONTROL SYSTEM HAS BEEN MORE COMPLICATED THAN THE BAY AREA RAPID TRANSIT DISTRICT ANTICIPATED

The Bay Area Rapid Transit District (BART) is paying more money than it anticipated for a computer system with a less comprehensive design than was provided for in the original contract with the Lawrence Berkeley Laboratory (laboratory) in 1980. BART underestimated the cost of the equipment and labor needed to complete the Integrated Control System (ICS), made major changes in the design of the system, and attempted, unsuccessfully, to take responsibility for the technical management of the project. In addition, Logica Systems, Incorporated (Logica), the second contractor for the ICS, had to correct deficiencies in the plan that it had developed for the ICS. As a result of these conditions, estimates for the total cost of the ICS have increased by more than \$25 million, and the target date for its completion has been delayed by more than five years. BART's most recent estimates for the ICS show a total cost of \$39.6 million with a completion date of May 1989, but neither of these estimates is guaranteed.

Inaccurate Cost Estimates and Delayed Completion Dates for the ICS

In September 1978, BART applied to the federal Urban Mass Transportation Administration for a grant of \$13.48 million. BART intended to use the grant for three separate projects, including the development of the ICS. At that time, BART management estimated that the ICS would be completed in early 1983 at a total cost of \$14.16 million. However, in April 1981, while working jointly, BART and the laboratory postponed the target date for the project's completion to mid-1984. BART and the laboratory attributed this delay to a difficulty in obtaining staff, to the need to develop more detailed specifications for computer equipment than originally anticipated, and to an underestimate of the project's complexity by both BART and the laboratory. This underestimate alone added 21 months to the time needed for developing software for the ICS.

In May 1981, BART requested that the federal grant be increased to a total amount of \$24.03 million. BART management explained that it had raised the estimated cost of the ICS by \$13.18 million (93 percent) to a total of \$27.35 million because BART had previously underestimated the cost of the ICS computer equipment and because BART needed to include additional costs for site preparation to BART facilities that was not part of the original plan. In November 1981, BART received only one bid for the computer equipment

needed for the ICS. Because this bid was for \$16 million, exceeding BART's estimate of the cost of such equipment by 78 percent, BART's board of directors rejected the bid.

By February 5, 1982, BART's general manager had recommended to the engineering and operations committee of BART's board of directors that the scope of the ICS be reduced. Specifically, the general manager recommended that BART should not proceed with the existing design for a network that would integrate several of BART's existing computer systems, which control, for example, train destination signs and fare collection information. Instead, the general manager recommended and the board approved a design that would replace only the existing train control system. He recommended this action to ensure that the ICS would be implemented at approximately the same time as BART's other capacity-improvement projects and to reduce the cost of the computer equipment for the project although he did not indicate the amount this change would save. While this change did reduce the cost of the ICS project, the savings ultimately were outweighed by cost increases for developing and producing software for the revised design.

At approximately the same time as BART and the laboratory dissolved their team effort, BART entered into a three-year agreement for \$2.97 million with the present contractor, Logica, which designated BART to be technical manager and Logica to provide professional services. This contract, which took effect in January 1983, also established January 1986 as the target date for completing the ICS.

However, in March 1984, BART relinquished the technical management of the ICS because its effort to manage the technical development of the project had been unsuccessful. In addition, in December 1984, key members of the Logica staff had departed, causing BART to extend the completion date to January 1987.¹ BART's general manager has stated that these departures contributed to the delay because Logica did not fill these vacancies with individuals of similar quality. At the time, the contract did not require Logica to assign any specific individuals to the ICS. The president of Logica has stated that both of Logica's first two site managers departed because they believed that the effectiveness of their contributions was hampered by the manner in which BART managed the project.

The next major revision in BART's cost estimate for completing the ICS occurred in September 1985. In a letter dated September 20, 1985, to the engineering and operations committee of BART's board of directors, the general manager stated that the estimate for the total cost of the ICS had increased from the 1981 estimate of \$27.35 million to a total of \$31.86 million, of which BART designated \$1.9 million for the train-reversing facility at Daly City. He attributed the balance of this increase to incorrect estimates by BART staff for the cost of both computer hardware and software in addition

¹On October 23, 1985, Logica presented its plan for completing the ICS. This plan revised the expected date of completion to October 1987.

to incorrect estimates for the cost of training, documentation, quality assurance, maintenance, and office rent and administration. The general manager explained that BART's estimates were incorrect partly because no working prototype existed for estimating the cost of new computer hardware to be installed at BART stations or the software this equipment would require.

On February 3, 1986, BART's general manager informed the board of directors that the technical documents that Logica had delivered on December 31, 1985, for the first stage of the project were deficient. He further stated that BART and Logica had agreed that Logica would improve these documents by February 27, 1986. BART had chosen not to authorize funds to Logica until the new documents were completed. On April 18, 1986, the general manager informed the board of directors that he was still dissatisfied with the technical documents that Logica had developed for the first stage of the project. Logica then offered to assign different technical managers to the ICS, and BART agreed to allow Logica to continue its work on the project. In June 1986, BART paid Logica the fees to which Logica was entitled and that BART had withheld for the prior six-month period.

During August 1986, Logica substantially revised its project plan for the ICS, causing the expected date of completion to be postponed from October 1987 to May 1989. While a previous project plan, dated October 1985, included the Daly City train-reversing facility within the scope of the ICS, the October 1985 plan did not

completely define the manner in which the ICS would control this facility. In addition, this earlier plan neither provided for ICS control of BART's new train cars, nor did it include provisions for testing Logica's work sufficiently to ensure the project's success. The additional work that Logica needed to conduct in order to address these deficiencies, and other matters, added 19 months to the time required for completing the project. Although the contract did not hold Logica financially liable for the additional time, both parties agreed that BART would pay Logica only 50 percent of the costs that Logica incurred for revising the plan.

In December 1986, the Logica project director recommended a significant change in the ICS design. Until that time, the design had included new computer hardware at BART stations for transmitting data such as train locations back to the central ICS computer. However, the Logica project director discovered that the new computer hardware would not be capable of operating a great enough portion of the time to meet the project's requirements for reliability and maintenance. He also discovered that, if BART would use the existing hardware at its stations and upgrade the new central computer, the ICS would be more reliable and more easily maintainable. Although BART estimates that this change saved between \$3 million and \$7 million in the cost of the hardware, these savings were outweighed by increases in the estimated cost of developing and producing central software for the revised design. Consequently, on May 20, 1987, BART's general manager increased the estimate of the final cost for completing the project from \$31.86 million to \$38.27 million.

BART had already spent over \$5 million on the design and development of the new hardware, \$3.5 million of which was in federal funds, but since new computer equipment for BART stations is no longer part of the ICS, the federal Urban Mass Transit Administration requested in August 1987 that BART either reimburse the federal government for any federal grant money used to develop the new hardware or substitute other eligible expenditures. BART's acting general manager has stated that BART will attempt to resolve this matter by submitting other expenditures that can be covered by federal funds, but as of October 31, 1987, this matter had not been resolved.

Finally, in August 1987, the general manager informed BART's board of directors that the estimate of the project's final cost as presented in May 1987 was incorrect. As a result of errors in estimation and cost analysis, BART had underestimated the overall cost of the project by \$1.3 million and should have projected it at \$39.6 million. The main component of this error was an omission of costs already incurred for leasing the central computer for the ICS.

As of October 31, 1987, BART had not further revised its estimates for either the cost of completing the project or the expected date of completion. (See Appendix B for an account of BART's revenues and expenditures for the ICS from March 1, 1980, through August 31, 1987.) Although BART's target date for the ICS project has

been extended from 1983 to May 1989, BART's acting general manager has stated that, while BART needs the ICS for future expansion, this delay will not affect current operations.

BART's Unsuccessful Attempt to Manage the Technical Development of the ICS

Before the start of the ICS project, all of BART's computer systems had been developed in a "turnkey" manner--BART had given design specifications to contractors who assumed complete responsibility for the management of the project and provided BART with a finished product. However, BART's contract with Logica in January 1983 required that Logica staff only assist BART managers in the development of the ICS. This agreement gave BART the responsibility for providing technical management for the ICS and placed Logica in the role of advisor and provider of technically proficient staff. Because BART was responsible for the technical management of the project, the original contract between BART and Logica did not require that Logica deliver finished products during the three-year term of the agreement.

Under BART's technical management, the work on the ICS project was not progressing well, so the general manager gave Logica the responsibility for technical management of the project during March 1984. BART took 15 months to make this change, causing an indeterminate delay in the completion of the ICS project. In March 1985, BART and Logica agreed to a memorandum of understanding that established deadlines for delivering documents and computer

prototypes, including software, resulting from Logica's work on the ICS project. Both of these actions served to make BART's contract with Logica more like a turnkey agreement although without a fixed price.

When BART decided to take responsibility for technical management of the ICS, it believed sufficient expertise existed within its own organization to make this arrangement succeed. However, the acting general manager has stated that, in retrospect, this assumption may have been incorrect, and, therefore, the original contract arrangement with Logica may have been inappropriate for BART. However, he further stated that, in 1982, BART was not prepared to offer sufficiently detailed specifications to contract for the ICS on a turnkey basis for a fixed price.

In March 1984, BART relinquished responsibility to Logica for the project's technical management, and, in October 1986, in a step to further improve the project's progress, BART contracted for the services of a full-time project manager to monitor the ICS. The project manager, whose primary responsibility is to monitor the ICS project, was hired to protect BART's interests during the remainder of the project. In addition, since August 1986, BART has contracted with a consulting firm, SRI International, for assistance in estimating the ICS cost and supervising the technical aspects of Logica's work on the ICS.

CONCLUSION

The development of the Integrated Control System has been more complicated than the management of the Bay Area Rapid Transit District originally anticipated, resulting in an overall increase in the project's cost estimate of more than \$25 million and an overall delay of more than five years in the project's completion. On several occasions since 1978, BART has underestimated the cost of the equipment, labor, and site preparation needed to complete the project. Major changes in the design of the ICS, BART's unsuccessful attempt to take responsibility for the project, the departure of key staff members, and the inability of Logica Systems, Incorporated, to deliver a satisfactory project plan have contributed to these increases and postponements.

RECOMMENDATION

To ensure that major future technical projects are conducted effectively and efficiently, BART should secure the short-term services of expert consultants who can accurately assess BART's ability to assume responsibility for the technical management of each project and who can recommend the type of contract that BART should offer for each project.

II

THE BAY AREA RAPID TRANSIT DISTRICT HAS IMPROVED
ITS CONTRACT WITH LOGICA SYSTEMS, INCORPORATED,
BUT SOME PORTIONS REMAIN UNFAVORABLE TO BART

Although BART has improved the terms of its agreement with Logica, some portions of the contract are still unfavorable to BART. BART's current contract with Logica establishes a risk-sharing arrangement for cost overruns and specifies key consultants that Logica must assign to the ICS. However, the cost of developing the ICS can still exceed BART's most recent estimate of \$39.6 million. In addition, under most circumstances, the agreement limits Logica's liability for breach of contract to \$1.6 million. After some research into the amount other contractors would charge, BART has concluded that the cost of replacing Logica with a different contractor would exceed the cost of retaining Logica to complete the project.

BART's original contract with Logica for \$2.97 million was intended to expire in January 1986. Between September 1983 and March 1987, BART's general manager recommended and the board of directors approved four change orders for the contract to pay Logica an additional \$4.99 million to continue its work on two of the seven stages of the project. In May 1987, the general manager reported to BART's board of directors that, as a result of negotiations with Logica, Logica would continue to work on the ICS, with completion as the goal, for an additional \$9 million.

The fourth change order for the contract, in March 1987, included addressing the cost for completing stages two and three of the project. Specifically, Logica agreed to a set of risk-sharing provisions wherein maximum budgets were established for completing each of these two stages, with Logica receiving only 50 percent of any fees it charged in excess of these limits. However, Logica can earn back any fees BART retains if Logica completes stages two or three for less than the maximum amount of fees allowed for that stage minus the amount established for contingencies. The fifth change order for the contract extended the risk-sharing provision to the final four stages of the project. For the final stages, four through seven, Logica can earn back retained fees if the sum of Logica's fees and BART's labor costs for these four stages is less than the maximum amount allowed minus the amount established for contingencies. If Logica earns back all of the money that BART retains for overruns, BART will pay Logica 50 percent of the difference between the budget for these stages and the fees Logica charges for completing these stages.

To ensure that qualified staff continue to work on the project, the fourth and fifth change orders to the contract require that Logica assign three specific key consultants to the ICS project. If Logica reassigns any of these three consultants without BART's prior approval, it must promptly provide replacements who are acceptable to BART, and further, Logica may be subject to financial penalties. Moreover, these change orders require that Logica submit to BART requests to replace any other staff and that Logica submit these

requests ten working days before the proposed replacement. BART then has the right to reject any such request so long as it does not exercise this right unreasonably.

While BART has improved upon its original arrangement with Logica, portions of the current agreement between the two parties are not favorable to BART. For example, the current contract contains a limitation-of-liability provision that prevents BART from recovering more than \$1.6 million if Logica is guilty of a breach of the contract. Before the fourth change order, the contract did not contain such a provision. In addition, because the risk-sharing provisions previously mentioned will force Logica to assume only one-half of the responsibility for cost overruns, no provision exists to ensure that Logica will complete the ICS project within the \$17.87 million maximum the contract establishes. In other words, while cost overruns have become a shared responsibility, BART still risks having to pay Logica an unspecified amount of additional fees to complete the project.

Another unfavorable aspect of the present contract is that the \$17.87 million maximum this contract establishes is more costly than BART staff originally estimated. BART's acting general manager and project manager for the ICS have stated that, despite BART's lower estimate for completing the project stages, BART was unsuccessful in attempts to negotiate a reduction in Logica's price. As a result of these negotiations and the four previous change orders to the contract, which increased Logica's responsibilities, BART will pay as much as

\$17.87 million to Logica under the current agreement, six times as much as BART's original contract with this organization, without any assurance that Logica will complete the project for that amount.

BART's project manager for the ICS has stated that his analysis of research earlier this year showed that retaining Logica would be less costly than selecting another contractor. Specifically, his own estimate of the amount a different contractor would charge and the estimate he received from a firm capable of developing the ICS were each several million dollars higher than the total price Logica offered for completing all of the project's stages before it would start earning fees at 50 percent of the normal project rates, as established by the risk-sharing agreement. Although the current contract allows BART to dissolve the agreement at any time, BART's acting general manager and ICS project manager further stated that they are now confident that Logica can complete the project; however, Logica's failure of any of the upcoming major tests of the ICS would result in BART's reconsideration of the decision to continue with Logica.

The first of these tests, designed to provide information on Logica's ability to successfully complete the ICS project, occurred in October 1987. However, while Logica passed this important test, both Logica's project director and BART's project manager of the ICS have stated that the remaining tests scheduled for 1988 are equally important in determining the success of the project.

CONCLUSION

Although the Bay Area Rapid Transit District has improved the terms of its contract with Logica Systems, Incorporated, some portions of the current agreement are unfavorable to BART. BART's present contract with Logica establishes a cost-sharing arrangement for cost overruns and specifies key consultants that Logica must assign to the ICS; however, it does not ensure that Logica will complete the Integrated Control System within the \$17.87 million ceiling the contract establishes. BART's project manager for the ICS has conducted research to determine the amount other contractors would charge to complete the ICS, and he has concluded that the cost of replacing Logica with a different contractor would exceed the cost of retaining Logica to complete the project.

RECOMMENDATION

To ensure that the Integrated Control System is developed effectively and efficiently, the general manager and board of directors of the Bay Area Rapid Transit District should analyze the results of upcoming tests of the ICS to determine if Logica Systems, Incorporated, can successfully complete the project. If these results indicate that Logica cannot complete the project, BART should select a new contractor.

III

THE BAY AREA RAPID TRANSIT DISTRICT PAID LOGICA SYSTEMS, INCORPORATED, \$28,000 MORE THAN IT WAS ENTITLED TO RECEIVE

Under normal circumstances, the Contract Management Department of BART independently reviews the timesheets that Logica submits for reimbursement. As part of this review, timesheets are cross-checked against the corresponding invoices to ensure that BART pays Logica only the amount it is entitled to receive. However, according to BART management, between January 1986 and June 1986, BART had not authorized funds for reimbursing Logica; consequently, BART's Contract Management Department did not review the timesheets and invoices that Logica had submitted for work on the ICS during this six-month period. BART management has stated that, during this period, it had chosen not to authorize funds for reimbursing Logica until Logica fulfilled its obligation to deliver key documents needed for the ICS. Once BART approved additional funds in June 1986, BART compensated Logica for its work through special check requests, bypassing the normal review process.

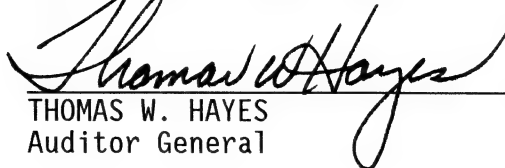
During the course of our audit work, we discovered that BART had made an inappropriate payment of approximately \$10,000 to Logica for work conducted during March 1986. We presented this information to BART's project administrator for the ICS, who promptly took corrective action to recover the amount in question.

As a result of our audit, BART reviewed all of the timesheets and invoices Logica submitted between June 1986 and May 1987. During this review, BART discovered additional overpayments to Logica totaling \$18,000. BART's project administrator for the ICS has stated that he is taking corrective actions to recover these payments, and, as of October 26, 1987, BART was in the process of conducting a similar review for the months between January and June 1986.

Finally, because of these discoveries, BART has modified its computer database for tracking payments to Logica. These modifications will improve BART's ability to review payments by facilitating direct comparisons between timesheets and invoices. This corrective action should prevent future overpayments to Logica.

We conducted this review under the authority vested in the Auditor General by Section 10500 et seq. of the California Government Code and according to generally accepted governmental auditing standards. We limited our review to those areas specified in the audit scope section of this report.

Respectfully submitted,


THOMAS W. HAYES
Auditor General

Date: December 7, 1987

Staff: Steven L. Schutte, Audit Manager
Peter Allyn Goldstein
Bernie Orozco

APPENDIX A

A HISTORY OF THE BAY AREA RAPID TRANSIT DISTRICT'S CONTRACT WITH LOGICA SYSTEMS, INCORPORATED

During the course of our audit work we conducted a comprehensive review of the contract that the Bay Area Rapid Transit District (BART) entered into with Logica Systems, Incorporated (Logica), in addition to all of the change orders that BART and Logica approved for the original contract. The chronology of these events follows:

January 25, 1983--BART contracted with Logica for assistance in developing the Integrated Control System (ICS). The three-year contract ending January 24, 1986, gave BART responsibility for providing technical management for the project. Logica's role was to assist BART in developing the ICS, including preparing specifications for computer hardware, formulating methodology for developing computer software, and developing techniques for testing the system. The contract established five hourly rates for work done by Logica staff, ranging from approximately \$29 to \$62 per hour. These rates included Logica's overhead and profit in addition to employee salaries and benefits. Although some evidence exists that BART reviewed and approved the hourly rate that Logica requested for each of its employees, the contract specifies no procedures for this review. The contract also authorized reimbursement, subject to BART's prior approval, for travel and per diem expenses of Logica's employees, in addition to expenses for materials, supplies, or services not specifically mentioned in the contract. The maximum amount BART agreed to pay Logica under this agreement was \$2.97 million.

September 15, 1983--Both parties approved the first change order for the contract effective on this date. This action authorized reimbursement to Logica when BART could not provide sufficient office space for Logica staff. Subject to BART's prior approval and as outlined in the contract, BART would reimburse Logica for the cost of renting office space and an additional 9 percent of that cost for general and administrative expenses.

March 23, 1984--BART's general manager relinquished BART's responsibility for technical management of the project to Logica. Specifically, BART authorized the Logica project director to take responsibility for technical management of the project, to assign both BART and Logica staff to specific duties, and to manage the budget BART established for the project.

August 8, 1984--Both parties approved the second change order for the contract effective retroactively to January 1983. This action amended the schedule of hourly rates for Logica staff by establishing two additional pay levels for Logica staff. As a result of this change, Logica's hourly rates ranged from approximately \$29 to \$97 per hour.

March 15, 1985--BART and Logica both approved a memorandum of understanding formalizing BART's decision on March 23, 1984, to give Logica responsibility for technical management of the project. This memorandum also required that Logica deliver documents and computer prototypes, including software, to BART.

November 1, 1985--Both parties approved the third change order for the contract effective on this date. This action extended the duration of Logica's contract to October 31, 1987, the new expected date of completion for the project. In addition, this change marked the first time in the history of the contract that BART required Logica to deliver documents. BART required that Logica deliver five documents, including a set of detailed specifications for the ICS, the ICS high-level design, the design for new computer equipment to be installed at BART stations and train yards, a request for proposals to supply this equipment, and a survey of BART's site for the ICS. These documents constituted the first stage of the project and were due by December 31, 1985. This change order for the contract increased the maximum amount of the contract to \$3.82 million.

June 17, 1986--BART's general manager informed the board of directors that Logica had agreed in principle to an arrangement in which BART and Logica would share in the costs or savings resulting from any stage of the project that Logica completed for more or less than the targeted amount.

March 2, 1987--Both parties approved the fourth change order for the contract. This action formalized the cost-sharing arrangement previously agreed to on June 17, 1986, and provided for an additional \$4.14 million to be paid to Logica for completion of the project's second and third stages. This figure was based on a new schedule of eight hourly rates retroactive to January 1, 1986, ranging from \$30 to \$120 per hour. In addition, to prevent the loss of key staff members, this action obligated Logica to retain three staff members, specified by name, on the project. If Logica removes these staff without BART's prior approval, Logica is subject to financial penalties. Finally, the fourth change order for the contract limited Logica's liability under most circumstances to \$1.6 million in the event of a breach of contract.

May 20, 1987--BART's general manager informed the board of directors that BART and Logica had agreed upon the tasks that would comprise the final four stages of the project.

September 18, 1987--Both parties agreed to the fifth change order for the contract effective on this date. This action established that BART would pay Logica an additional \$9.91 million for work conducted through stage seven. This figure would be based on a new schedule of hourly rates ranging from approximately \$31 to \$123 per hour effective retroactively to January 1, 1987. While the change order restricted total payments to \$17.9 million, it does not require Logica to complete the project for that amount.

As of August 31, 1987, BART had paid Logica \$9.017 million. Of this amount, \$8.847 million was paid for Logica's services according to the hourly rate schedule, and \$170,000 was paid to Logica as reimbursement for material expenses, predominantly leasing equipment and purchasing supplies.

APPENDIX B

A SUMMARY OF THE BAY AREA RAPID
TRANSIT DISTRICT'S REVENUES AND EXPENDITURES
FOR THE INTEGRATED CONTROL SYSTEM
MARCH 1, 1980 THROUGH AUGUST 31, 1987

	<u>Amount</u>
<u>Revenues</u>	
Federal grant	\$16,426,000
State assistance	5,693,000
Bridge-toll revenue	1,319,000
BART bond sales	463,000
BART interest earnings	707,000
Other	<u>26,000</u>
Total Revenues	<u>\$24,634,000</u>
<u>Expenditures</u>	
BART labor	3,868,000
Payments to Lawrence Berkeley Laboratory	3,743,000
Payments to Logica Systems, Incorporated	9,017,000
Payments to other consultants	1,285,000
Computer hardware	5,136,000
Rental of office space	1,019,000
Other	<u>566,000</u>
Total Expenditures	<u>\$24,634,000</u>

Source: BART's Capital Program Control Department provided this
unaudited data.



BAY AREA RAPID TRANSIT DISTRICT
800 Madison Street
P.O. Box 12688
Oakland, CA 94604-2688
Telephone (415) 464-6000

November 25, 1987

MARGARET K. PRYOR
PRESIDENT
BARCLAY SIMPSON
VICE-PRESIDENT
KEITH BERNARD
GENERAL MANAGER

Mr. Thomas Hayes
Auditor General
State of California
660 J Street, Suite 300
Sacramento, CA. 95814

Dear Mr. Hayes:

Enclosed are the two draft copies forwarded to us for comment regarding the audit of BART's Integrated Control System. We have no written comments to offer.

I appreciate and thank you for your candid and unbiased handling of this matter. If I can be of further assistance on this issue, please let me know.

Sincerely,

A handwritten signature in cursive script, appearing to read "R P Demko".

R. P. Demko
Acting General Manager

DIRECTORS
BARCLAY SIMPSON
1ST DISTRICT
NELLO BIANCO
2ND DISTRICT
ARTHUR J. SHARTSIS
3RD DISTRICT
MARGARET K. PRYOR
4TH DISTRICT
ROBERT S. ALLEN
5TH DISTRICT
JOHN GLENN
6TH DISTRICT
WILFRED T. USSERY
7TH DISTRICT
ARLO HALE SMITH
8TH DISTRICT
JOHN H. KIRKWOOD
9TH DISTRICT

cc: Members of the Legislature
Office of the Governor
Office of the Lieutenant Governor
State Controller
Legislative Analyst
Assembly Office of Research
Senate Office of Research
Assembly Majority/Minority Consultants
Senate Majority/Minority Consultants
Capitol Press Corps